Ray Thelwell 6 January 1960

1. Mathematical Programming

a. Index Method. An approximation technique.

(1) Index Number: Man Hours Required in any plant divided by least man hours/day plant.

Operations Research Methods & Problems
Sasieni Wiley

6 January 60

Linear Programming

Factors in Identity and constants must be positive

a. Restrictions $\leq$ $\begin{cases} 7x+6y \leq 84 \\ 7x+6y+w_1 = 84 \end{cases}$

b. Requirements $\geq$ $\begin{cases} 5x+2y \geq 15 \\ 5x+2y-w_2+v_1 = 15 \end{cases}$

c. Approximation $\cong$ $\begin{cases} 6x+5y \cong 50 \\ 6x+5y-w_3+w_4 = 50 \end{cases}$

x	y	w_2	w_3	w_1	v_1	w_4
7	6			1		
5	2	-1			1	
6	5		-1			1
2	b	0	-1	0	-M	-1

d. Equations $\begin{cases} 3x+4y = 100 \\ 3x+4y+v_2 = 100 \end{cases}$

$\uparrow$ -M

6 Jan 60 pm

object column	variable column	constant column	Body	Key column	Identity		slack column			
			2	3	0	0				objective row
			X	Y	W_1	W_2				variable row
0	W_1	30	3	4	1		38			
0	W_2	60	2	5		1	68			
		0	-2	-3	0	0	-5			Index row
3	Y	$\frac{30}{4}$	$\frac{3}{4}$	1	$\frac{1}{4}$	0	$\frac{38}{4}$			Main Row
	W_2	$\frac{90}{4}$	$-\frac{7}{4}$	0	$-\frac{5}{4}$	1	$\frac{82}{4}$			
		$\frac{90}{4}$	$\frac{1}{4}$	0	$\frac{3}{4}$	0	$\frac{94}{4}$			Index row

repeat iteration until no negative numbers in index row.

index Number = $\sum$ {(number in col)(corresponding (number in obj col)} - (No in object row at head of col)

$(3.0) + (2.0) - 2 = -2$

Key row = Dividing Constant column by Key col.

$W_1 = \frac{30}{4} = 7.5$, $W_2 = \frac{60}{5} = 12$ choose smallest

6 Jan 60 pm

positive ratio.

Key Number : common element in key row and key column

Main Row : divide each number in key row by key number -

Element in new tableau = Corresponding element in old tableau − $\left(\frac{\text{corresponding element in key row} \times \text{corresponding element in key column}}{\text{key number}}\right)$

$= 60 - \left(\frac{30 \times 5}{4}\right) = \frac{90}{4} = \frac{45}{2}$

$= 2 - \frac{3 \times 5}{4} = -\frac{7}{4}$

$= 5 - \frac{4 \times 5}{4} = 0$

$= 0 - \frac{1 \times 5}{4} = -\frac{5}{4}$

$= 1 - \frac{0 \times 5}{4} = 1$

$= 68 - \frac{38 \times 5}{4} = 68 - \frac{190}{4} = \frac{82}{4}$

$= 0 - \frac{30(-3)}{4} = \frac{90}{4}$

6 January 60

Variations on Simplex Problem

Idle time process I cost $\frac{1}{2}$

Idle time process II Cost # 1

objective row modify 2 | 3 | $-\frac{1}{2}$ | -1

~~Idle time process I cost~~ ~~Idle time process II cost~~

$2x + 3y - \frac{1}{2}w_1 - w_2 = \text{Min.}$

Maximum no of pieces $x + y = \text{Max}$

objective row 1 1 0 0

Another requirement $x = 4$

$x + w_3 = 4$

attach high cost to w_3 arbitrarily which would make it disappear.

Minimize idle time $w_1 + w_2$ becomes $-w_1 - w_2$